the photogenic organ, by which the two layers are formed. About this time the tracheal and nerve connections become fully established. At the age of twenty-two days the organ begins to emit light.

In this connection it may be stated that my observations confirm Dahlgren's recent announcement that the adult organs in the pupa arise from the hypodermis.

Walter N. Hess

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JOSEPH YOUNG BERGEN

To the Editor of Science: In my paper in memory of Joseph Young Bergen, which appeared in Science, January 4, 1918, I stated that he was the son of a clergyman. I am now informed by Mrs. Bergen that this statement is incorrect.

Edwin H. Hall

Cambridge, Mass.,
January 30, 1918

SCIENTIFIC BOOKS

The Casting-Counter and the Counting-Board. A Chapter in the History of Numismatics and Early Arithmetic. By Francis Pierrepont Barnard. Oxford. At the Clarendon Press. 1916. 357 pp. + LXIII. plates. Price £3 3s.

When we consider the rôle played by the abacus in the history of calculation, first as the primitive and probably prehistoric dust board and finally in the form of the elaborate reckoning machines of the present day, we can see that the history of mechanical computation is closely tied up with the history of the race. It is true that for long periods we have no reference to such a device as the abacus, but for equally long periods we have no reference to many of the common customs of life and to the everyday implements used in the home. It is probable that one would have to search long in the written records of the early periods to find any reference to such homely words as button or shoestring, or to such common actions as the combing of the hair, the milking of a cow or a goat, the cooking of a piece of beef, or the making of a sandal or a shoe, and yet all these words and actions have been commonplaces for thousands of years. The recording of the use of common devices is generally inversely proportional to the frequency of their use, and this is probably one reason why the abacus, in one form or another, is not more frequently mentioned in the chronicles of various peoples.

There were three standard forms of the abacus in ancient times, the dust board, which was the forerunner of the wax tablet as the latter was of the slate; the board on which counters or small disks were moved about, these counters appearing in Rome as pebbles or marbles (calculi); and the bead abacus, the counters running in grooves or on wires, a form still found in schools in our country and familiar as the Chinese *suanpan,* the Japanese *soroban,* and the Russian *tschotü* or the Armenian *choreb.*

Of these various forms, the most interesting for the general reader of the Western World is the board on which calculi were moved, since these counters are so often mentioned in our literature. Adelhard of Bath (c.1120) speaks of such a table, saying that "quidem mensam pithogoream ob magistri sui reuerentiam. sed postī tamē abacum dixerunt," having probably in mind a passage from Boethius: "Pythagorici vero . . . mensam Pythagoream nominabant . . . a posteribus apellabatur abacus." We find the name of *abacisti* given to those who were skilled in computation with the counters, and even the verb "to abacus" is occasionally found, as in a certain manuscript of the eleventh century—"Hoc si abacizando probaveris." In later times the references to counters become very numerous. So we have in English such expressions as "Sitte doun and take countures rounde," "A nest of cowntouris," "The kitchin clarke . . . jangling his counters," "A counter caster," "Any that can but cast with Counters," and "I shall reken it syxe tymes by aulgorisme or you can caste it ones by counters." From the use of the word as representing a disk we also find it employed to represent the person, as in the expression, "Ther is no countere nor clerke con hem recken alle," and also to repre-

sent the table, as in the expression "Thogh Argus (that is, al-Khowarizmi) the noble covnter Sete to rekene in hys counter." The story is connected with Fitz-Neal's "*Dialogus de Scaccario*" of 1178 and the court of the exchequer, with backgammon, and with divers other ramifications. The counter went by various names, such as Rechenpfennig, Zahlpfennig, and Raitpfennig in Germany; projectiles and abaculi as well as calculi in Latin; jetons, gectz, getoirs, giets, and the like in France; Leggelt and Werpgeld in Holland; and jettons and Venetian money as well as counters in England.

It is the field of counters that Professor Barnard has made his own in the monumental and sumptuous work under review. For many years he has been collecting specimens of counters of the various European countries. He has examined upwards of 40,000 specimens and has in his own cabinet some 7,000, most of those described being in this collection. With great care he has selected typical specimens, the choice being determined by their historical importance, artistic merit and general value. Fifty-nine Early English jettons are described, nineteen Italian, three hundred seventy-two French, ninety Low Country, one hundred twenty-two German, and four Portuguese. Each specimen is illustrated photographically and each is described with all the care of a trained numismatist. Nothing could be more satisfactory to the collector or the student, and it would be difficult to suggest a single particular in which the descriptive material could be improved.

To the historian of mathematics one of the items of greatest value is the set of photographs of reckoning tables at Basle and Nürnberg, of reckoning cloths at Munich, of illustrations from manuscripts and early printed books, and of Dutch jetton cylinders, together with a description of each. There is also a valuable list of one hundred fifty-nine extracts from English inventories with references to counting boards, thus showing that these devices were common from the fourteenth to the sixteenth century at least. The first two of these extracts, of date 1321 and 1337, respectively, make mention of "Camera quædam cum mensa quadrata ad calculandum" and of "Unum computatorium," while other interesting items refer to "the cheker," "counting-bord," "unum scaccarium," "cowntynge borde or table," "accomptyng borde," "unam mensam vocatam a counter," and "the counterborde in the Hall."

Perhaps the most important part of the work from the standpoint of the historian is that on "the methods of casting with jettons" (pages 254–319). Here Professor Barnard has given a very satisfactory summary of the more important European works on the subject, such as those by Recorde, Awdeley, Reisch, Cusanus, Siliceus, Köbel, de Moya, and Trenchant. There should also be mentioned as of great value to students the bibliography of upwards of six hundred titles.

Taken as a whole the work may be safely characterized in superlatives. Such an elaborate treatise on any special field of the history of mathematics has never before appeared, nor are we likely soon to see another. The infinite pains taken by the author in his research, the munificence shown in the publication itself, and the fact that a mass of technical material is presented in a style that makes every page readable, all combine to render the work unique in its way. No library of reference can afford to be without the book, and students of the history of mathematics should add it to their personal libraries as soon as they can arrange to do so. It will be the classic upon the subject for generations to come.

DAVID EUGENE SMITH

The Nature of Solution. By HARRY C. JONES. New York, D. Van Nostrand Co. 1917. 23 x 15 cm.; pp. xxiv + 380.

The present work is not a text-book, but a general discussion of some of the more important properties of solutions, true and colloidal. It is therefore written in a non-mathematical, indeed, largely in a semi-popular style. It is hoped that this work may interest students of the various branches of science to go on into the real physical